DOCUMENT RESUME

ED 456 865 IR 058 404

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TITLE	The National Science Foundation's Massive Digital Library for Education: Opportunities and Challenges for Teachers and Librarians. ERIC Digest.
INSTITUTION	ERIC Clearinghouse on Information and Technology, Syracuse, NY.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
REPORT NO	EDO-IR-2001-10
PUB DATE	2001-12-00
NOTE	4p.
CONTRACT	ED-99-CO-0005
AVAILABLE FROM	ERIC Clearinghouse on Information & Technology, Syracuse University, 621 Skytop Rd., Suite 160, Syracuse, NY 13244-5290. Tel: 315-443-3640; Tel: 800-464-9107 (Toll Free); Fax: 315-443-5448; e-mail: eric@ericir.syr.edu; Web site: http://ericit.org.
PUB TYPE	ERIC Publications (071) -- ERIC Digests in Full Text (073)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Access to Information; *Educational Resources; *Electronic Libraries; Elementary Secondary Education; Higher Education; *Information Networks; Information Sources; *Instructional Materials; Mathematics; Online Systems; Program Development; Science Education; Technology Education
IDENTIFIERS	ERIC Digests; National Science Foundation

ABSTRACT

The National Science Foundation (NSF) released its first call for proposals for the National Science, Mathematics, Engineering, and Technology Education Digital Library (NSDL) program early in 2000. Building on work supported under the multi-agency Digital Libraries Initiative, this program aims to establish a national digital library that will constitute an online network of learning environments and resources for science, mathematics, engineering, and technology education at all levels. The "virtual facility" envisioned by the program is intended to serve the needs of students and teachers alike at all levels (pre-K through 12, undergraduate, graduate, and lifelong learning) by providing seamless access to rich interactive learning materials and resources, marked by the breadth and depth of the subject matter addressed, and valued for their authority and reliability. The NSDL will also enhance the services of existing libraries through the intelligent retrieval of relevant information, indexing and online annotation of resources, and archiving. The NSDL program features four tracks: Core Integration, Collections, Services, and Targeted Research. In fiscal year 2000, 89 proposals were received across these tracks requesting approximately 59 million dollars. In September 2000, 29 new awards were made, and in September 2001, grants were awarded to support 35 new projects. As the NSDL program begins its second full year of project support, there are numerous challenges and opportunities that present themselves. (Contains 10 references. A list of projects of particular interest to the ERIC community is also provided.) (AEF)

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ED 456 865

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ERIC Digest

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IR058404

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ERIC Digest

DECEMBER 2001

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EDO-IR-2001-10

The National Science Foundation's Massive Digital Library for Education:

Opportunities and Challenges for Teachers and Librarians

By Lee L. Zia

The National Science Foundation (NSF) released its first call for proposals for the National Science, Mathematics, Engineering, and Technology Education Digital Library (NSDL) program early in 2000. Building on work supported under the multi-agency Digital Libraries Initiative, this program aims to establish a national digital library that will constitute an online network of learning environments and resources for science, mathematics, engineering, and technology education at all levels.

Background

Fiscal year 1994 marked the beginning of the Digital Libraries Initiative (DLI), a multi-agency research effort involving the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), and the Department of Defense's Advanced Research Projects Agency (ARPA). NSF served as the lead agency in this program that provided support for basic research into the transformative potential of information technology as applied to library and information science.

Six multi-year projects were funded in the first four years, featuring collaborations of researchers and users from a variety of organizations, including leading universities, state agencies, secondary schools, prominent libraries and museums, the publishing community, government laboratories, and the computer and communications industry. In a brief note in *Educom Review*, Paul Evan Peters (1995) provided very short summaries of these projects; but more importantly he posited the term "digital library" as the logical replacement for what Peters called two prior terms of art: the "electronic library," with its basic "bits on silicon rather than ink on paper" concept, and the "virtual library," as captured in the idea of "not only what you own but what you have access to." (It bears mentioning that this same early to mid-1990s time period also marked the emergence of the first text-based browsers, which were followed very quickly by graphical browsers.)

In 1995 initial thinking about digital libraries for science education began with an internal concept paper for the NSF Division of Undergraduate Education (DUE), and the concepts were developed and informed by a series of workshops and accompanying reports (Manduca & Mogk, 1999; NRC, 1998, 1999; NSF, 1998, 1999a, 1999b). By FY98 the initial DLI had gained more partner agencies and under the umbrella of a new DLI-2 effort, a prototype program was conducted for two years to explore the application of digital library research to undergraduate science education test beds. Spurred by both enthusiasm from the broad educational community and both the legislative and executive branches for the promise of digital libraries to enable improvements in education, the formal NSDL program (http://www.ehr.nsf.gov/ehr/due/programs/nsdl) was established in 2000.

The "virtual facility" envisioned by the program is intended to serve the needs of students and teachers alike at all levels – preK-12, undergraduate, graduate, and life-long learning, by providing seamless access to rich interactive learning materials and resources, marked by the breadth and depth of the subject matter addressed, and valued for their authority and reliability. The NSDL will also enhance the services of existing libraries through the intelligent retrieval of relevant information, indexing and online annotation of resources, and archiving. Moreover, the emerging broadband potential of the Next Generation Internet offers new capabilities, such as access to virtual collaborative work areas, interactive networked laboratory experiences, tools for analysis and visualization, remote operation of instrumentation, mining of large databases of real-time data, and exploitation of simulated environments. By enabling broad access to comprehensive high-quality collections of teaching and learning resources in a digital environment, along with value-added services, the NSDL is expected to encourage and support continual improvements in the quality of science, mathematics, engineering, and technology education for all students.

Current Projects

The NSDL program features four tracks: Core Integration, Collections, Services, and Targeted Research. In the core integration track, projects are expected to focus on the coordination and management of the library's core collections and services and to develop the library's central portal. Collections track projects are expected to aggregate and manage a subset of the library's content within a coherent theme or specialty, while services projects are expected to develop services that support users, collection providers, and the core integration capabilities that enhance the impact, efficiency, and value of the library. Finally targeted research projects are expected to explore specific topics that have immediate applicability to one of the other three tracks.

In fiscal year 2000 eighty-nine proposals were received across these various tracks requesting approximately 59 million dollars. Twenty-nine new awards were made in September 2000 including six pilot projects in the core integration track (Zia, 2000). In FY01 the program received one hundred and five proposals across its four tracks requesting approximately 74 million dollars. In September 2001 grants were awarded to support thirty-five new projects: one full development project in the core integration track, eighteen projects in the collections track, thirteen in the services track, and three in targeted research (Zia, 2001b).

Although the first-year grants are barely a year old, projects have been developing and testing prototype models of aspects of the NSDL. Issues being addressed include collection development policies, distributed review and quality control, user access and authentication

services, standards development, metadata frameworks, and intellectual property. Because the program is seeking to build an enterprise much larger than any individual project, there has been a conscious effort on the part of NSF and the principal investigators of the various grants to foster a collective sense of mission. For example, project participants have self-organized into various working groups (see <http://www.smete.org/nsdl/workgroups>) that are helping to define user requirements and to develop technical specifications such as protocols for tagging resources with metadata and indexing taxonomies to facilitate searches. A fundamental organizational and technical infrastructure is also being created to support the interoperability of the distributed collections and services.

Challenges and Opportunities

As the NSDL program begins its second full year of project support there are numerous opportunities and challenges that present themselves (Zia, 2001a). With respect to the preK-12 community, the traditional roles for librarians and teachers are evolving, just as they are beginning to evolve at the post-secondary level. If indeed the distinctions between the two roles are blurring, and the requisite skills of each are enlarging, then there are certainly implications for pre-service preparation and continued professional development.

As new learning resources become available, new materials and curricular development possibilities also open up, along with opportunities to reuse, repackage, and repurpose the digital learning objects. New sources of such materials are also becoming available, for example the vast museum holdings whose availability to date has been bound by place. Recognizing the opportunities in this area, NSF and another federal agency, the Institute for Museum and Library Services (IMLS), have brought together a set of grant recipients to explore ways in which library and museum holdings may be appropriately leveraged in support of new course and curricular materials. A joint IMLS-NSDL working group is currently developing a report of its activities.

There is also a key opportunity for teachers and librarians to provide important "end-user" perspectives to the development of the collections and services of the NSDL. In the previous section above various working groups were mentioned. Communication within these groups is primarily through public listserves, which can be accessed at the site given above. Participation in these discussions is strongly encouraged and will be especially valued.

Finally, evaluation in its many forms is exceedingly important to undertake as the NSDL continues to grow. Here again the teacher and librarian communities represent a vital resource to be tapped by the various projects in the NSDL program. Plans are underway for evaluation of a variety of aspects of the digital library including ease of accessibility, user satisfaction with content and services, the use made of materials, documentation of learning gains due to using NSDL material, to name but a few.

The NSF conceives of the NSDL as a community-built and community-governed public resource for the nation's students and teachers. Significant involvement of the country's teachers and librarians will be vital to achieving this vision.

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Projects of Particular Interest to the ERIC Community

Available at: http://www.ehr.nsf.gov/ehr/due/programs/nsdl/

Core Integration Track

DUE 0127298, 0127308, and 0127520: *Collaborative Project: Core Integration of the National SMETE Digital Library*. Institutions: University Corporation for Atmospheric Research (UCAR), Cornell University, and Columbia University. PIs: Dave Fulker, Bill Arms, and Kate Wittenberg.

Collections Track

DUE-0085874. *Biology Education Online - An Interactive Electronic Journal*. Institution: National Association of Biology Teachers. PI: Wayne Carley.

DUE-0085823. *National Digital Library for Undergraduate Mathematics, Science, and Technology Teacher Preparation and Professional Development*. Institution: Ohio State University. PI: Kim Roempler.

DUE 0121636. *Teachers Domain Collection: Life Sciences, K-12*. Institution: WGBH Educational Foundation. PI: Michele Korf.

DUE 0121650. *National Digital Library for Technological Literacy*. Institution: International Technology Education Association. PI: Brigitte Valesey.

DUE 0121677. *Gender and Science Digital Library*. Institution: Education Development Center. PI: Katherine Hanson.

DUE 0121724. *Water in the Earth System (WES): An NSDL K-12 Collection Project*. Institution: Colorado State University. PI: Ed Geary.

Services Track

DUE-0085855. *The Instructional Architect: A System for Discovering, Recommending, and Combining Learning Objects*. Institution: Utah State University. PI: Mimi Recker.

DUE 0121525. *Developing Virtual Reference Desk Capabilities for the NSDL*. Institution: Syracuse University. PI: Richard Lankes.

DUE 0121692. *Digital Library Services for American Indians*. Institution: American Indian Higher Education Consortium. PI: Carrie Billy.

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